Clemson IPM Program Newsletter

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Integrated pest management is an ecologically-based approach to managing pests with an emphasis on using multiple management strategies. The principles of IPM can be applied to any pest of food or fiber production systems, landscapes, and urban environments. IPM considers multiple control tactics with the aim of minimizing selection pressure on one given tactic.

The Clemson IPM program (https://www.clemson.edu/extension/ipm/index.html) seeks to increase adoption of IPM practices in South Carolina by developing interdisciplinary, research based information, and providing it to the public in efficient and accessible formats. The goals of the IPM program are driven by the needs of stakeholders, who have an integral part in developing the priorities of the current program.

The Clemson IPM Newsletter will provide updates on research, extension programs, successes in IPM, important dates, and more!

@IPM_Clemson

Follow the Clemson IPM program on Twitter for real time updates throughout the growing season

Meet the Team

The IPM program at Clemson is comprised of the coordination team, extension personnel, and researchers throughout the state.

Pee Dee REC
Francis Reay-Jones, *Field Crop Entomology*
JC Chong, *Specialty Crop Entomology*
Joe Roberts, *Turfgrass Pathology*
Ben Powell, *Pollinator Specialist*

Coastal REC
Tony Keinath, *Vegetable Pathology*
Matt Cutulle, *Vegetable Weeds*
Brian Ward, *Organic Vegetable*

Edisto REC
Jeremy Greene, *Field Crop Entomology*
Mike Marshall, *Field Crop Weeds*
Dan Anco, *Peanut Specialist*
John Mueller, *Field Crop Pathology*

Clemson Main Campus
Guido Schnabel, *Fruit Crop Pathology*
Juan Carlos Melgar, *Pomology*
Steve Jeffers, *Ornamental Crop and Tree Pathology*

UGA, Athens
Brett Blaauw, *Peach Entomologist*

Coordination Team
Francis Reay-Jones, *Program Coordinator*
Tim Bryant, *Associate Program Coordinator and Newsletter Editor*

Tell us what you think...

Please take a few minutes to fill out this survey to tell us what you would like to see in future editions of this newsletter!

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Improving Soil Organic Matter in Peach Orchards

Contributing author: **Brian Lawrence**

Ongoing experimetnal plots showing different organic matter amendments added to peach orchards.

Disease pressure is one of the main challenges that peach producers face in South Carolina. Both fungal and bacterial pathogens can be responsible for as much as 100% of fruit and tree losses in orchards without proper management strategies. Integrated management of diseases in peach orchards typically relies on a number of chemical, biological, and cultural controls including fungicides with varied modes of action, reduction of disease source material, and host plant resistance. While these strategies have been extensively studied and can be effective, there is always a demand for ways growers can improve management without significantly impacting their management costs. Soil health and organic matter content is one topic which has not been extensively studied for its impact on disease management in the southeast.

Peach growers usually manage an orchard with little to no soil cover, as herbicides and shade from mature peach trees often maintain bare soil . Over periods of time, this type of management negatively impacts the amount of carbon introduced back into the soil and in turn reduces the health and abundance of soil microbial community. Additionally, many southeastern soils where peaches are grown are easily eroded by wind and rain, further reducing the health of the soil. Often the soil microbial community which relies on organic matter can be beneficial for reducing soil borne disease pressure and facilitating efficient nutrient uptake for peach trees.

Brian Lawrence, a PhD candidate working with Dr. Juan Carlos Melgar and Dr. Guido Schnabel, has done several years of research to illustrate the benefits of increasing organic matter on nutrient management in peach orchards. "We currently have very little understanding of how increasing soil carbon, through the incorporation or surface addition of organic matter, may change how peaches acquire nutrients, achieve systemic resistance to pests or diseases, alter pest and disease cycles, change weed pressure" Brian said. To address this gap in knowledge, Brian conducted several studies to assess 1) the impact of food waste compost soil amendment on young orchards and 2) the impact of municipal mulch added to mature orchards.

For the first objective, food waste compost was incorporated into the soil before planting peach trees in 2019, and the tree growth, nutrient and water status was monitored for 4 years. Current results suggest that the high rate of compost in these plots provide a buffer for water retention, improving the amount of water available for young trees during dry periods. Trees treated with compost also have grown larger than their untreated counterparts, which directly impacts the yield potential of those trees. The fruit from these trees also typically have a higher concentration of mineral nutrition and have needed significantly less synthetic fertilizer to produce similar quality and quantity of fruit to the industry standard. Another researcher, Sydney Lykins, is monitoring the amount of bacterial spot in treated orchards, but no difference has yet been identified between treatments. By reducing synthetic inputs, growers could potentially reduce the environmental impact of chemical fertilizer.

Additional plots were treated with biochar and municipal mulch, in addition to the food waste compost. These trees have required no synthetic fertilizer in two years and have grown larger than traditionally managed trees, producing fruit with higher... (cont. page 3)

Ongoing experimetnal plots showing different organic matter amendments added to peach orchards.

nutrient content. This research suggest that food waste compost can reduce synthetic inputs, reducing environmental impact and saving growers money while maintaining industry standard levels of yield.

The second project involved applying municipal mulch in mature peach orchards. This study consisted of two treatments, mulch alone and mulch combined with poultry liter applied to fully grown peach trees in 2020. As seen in the previously described experiment, these trees received a reduced amount of synthetic fertilizer and had similar yield to traditionally managed trees while having improved mineral nutrients in the fruit. Initial results have also indicated that bacterial spot was reduced on trees and fruit in treated plots, which could potentially increase the total pack out volume for growers.

This research illustrates the importance of examining all possible tools available when implementing integrated pest management plans. Soil health and organic matter content can be overlooked as pest management tools, however in peach orchards they have the potential to reduce inputs in the form of synthetic fertilizers, limit disease material originating from the soil, and increase tree health and vigor resulting in decreased susceptibility to insect and disease pressure.

Clemson Hosts Scouting Schools and Field Days for Peanut, Cotton, Soybean, and Corn

Clemson Extension recently organized three scouting schools for cotton, soybean, and peanuts to teach growers about how to identify and scout for important pests of these crops. The scout schools were held On July 27, 28 and 29 at the Pee Dee Resaerch and Education Center, Lone Star Plantation in Orangeburg, and the Edisto Research and Education Center. Attendants went to the field with specialists for a hands on demonstration about the most common pests of each crop, how to identify each of the pests, and methods to scout for these pests. Learning what pests you are targetting and whether or not they have reached an economicly damaging population level are critical steps for an effective integrated management plan.

On August 4th at 9 am, a corn field day will be held at the Edisto REC.

Using Host Plant Resistance to Manage Fusarium Wilt of Watermelon

Contributing Author: **Dr. Anthony Keinath**

Left: Fascination grafted on to Carolina Strongback rootstock vs. Right: Tri-X-313 displaying symptoms of fusarium wilt at seven weeks after transplant.

Fusarium wilt, caused by the fungus *Fusarium oxysporum*, is a common vascular disease of watermelon that can cause significant yield loss under the right conditions. When infected, leaves will wilt and vines will decline. Often one side of the plant will display more severe symptoms then the other, which can help to identify the symptoms as fusarium wilt. To confirm the presence of fusarium wilt, the crown of infected plants can be cut open and inspected for brown streaks in the xylem. The soil is often the source of the fungus, so disease presence can be patchy and random throughout an infected field, depending on where the population is high.

The primary sources of inoculum for fusarium wilt are infected soil, plant material, and/or seeds. Once fusarium wilt is present in a field, it can produce spores which survive for 5-10 years in the soil and can infect future plantings when conditions are favorable. Cool and wet conditions in the spring favor the development of disease in young watermelon plants, but disease symptoms are often not seen until hot and dry conditions stress the plant later in the season.

Elimination of inoculum in the soil via the use of soil fumigation can be extremely costly for a grower. Once a plant is infected, fusarium wilt can be difficult or impossible to manage with fungicides, as the disease is located in the vascular tissue of the plant and thus protected from contact with fungicides. The visual symptoms of infection also present long after the infection occurred, further complicating the timing of fungicide use. Due to the limitations on fungicide use in managing this disease, it is critical to establish a cultural control program which limits the amount of disease material in the field, and includes the use of a resistant watermelon cultivar.

Dr. Tony Keinath, a vegetable pathologist at Clemson's Coastal Research and Education Center, conducted experiments in 2021 and 2022 to test the susceptibility of several different watermelon cultivars to fusarium wilt, and wilt effect on watermelon yield. "I was pleased to see the cultivars performed similarly in both years of the study, even though a lot of symptoms appeared yet in the last two weeks in 2022."

The cultivars tested included Fascination grafted onto Carolina Strongback rootstock, Fascination, Powerhouse, 7197HQ, El Capitan, Embasy, Tri-X-313, and Shoreline. Grafting involves combining the rootstock of one... (cont. page 5)

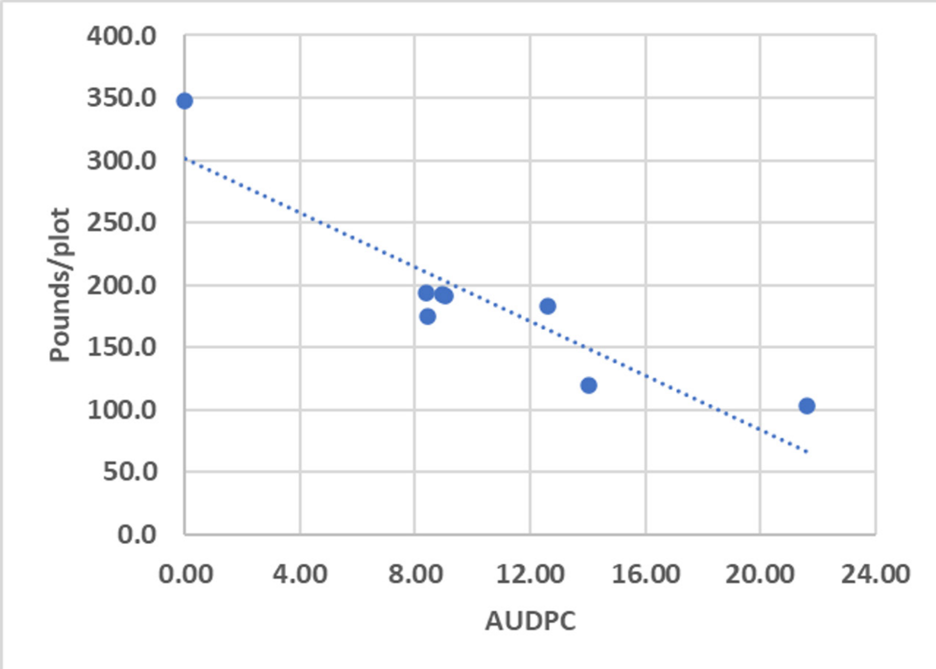

Figure 1. Watermelon yield vs. area under the disease progress curve (AUDPC). This figure illustrates that increasing incidence of fusarium wilt has a negative relationship with watermelon yield.

cultivar that may impart some beneficial quality, and the foliar portion of another cultivar which has characteristics more suitable for marketable fruit. Carolina Strongback rootstock imparts fusarium wilt resistance as well as resistance to nematodes in more susceptible but marketable watermelon cultivars. In addition to the benefits for disease control, watermelon grafted to Carolina Strongback produces uniform seedling growth, performs well under LED lights, and have a 90-100% grafting success rate.

There are two races of *Fusarium* present naturally in the experimental field each year. These two different races of *Fusarium* are of the same species but have different enough genetic profiles that host plant resistance may only apply to one race. Fascination, Powerhouse, and Embasy are rated for resistance to *Fusarium* race 1. Grafted Fascination is resistant to both *Fusarium* races due to the excellent resistance in the Carolina Strongback rootstock. El Capitan, 7197HQ, Tri-X-313, and Shoreline have no known or identified resistance genes to either race of *Fusarium*. For these two studies, all plots were in soil naturally infested with *Fusarium* race 1 and 2 and assessed for yield was assessed at three to four harvests. Yield data was separated into small, medium, large, and extra large fruit per 36 row feet as well as total marketable weight.

Across all cultivars, disease incidence had a significant negative relationship with yield, meaning increasing fusarium wilt reduced the overall yield (figure 1). Fascination grafted to Carolina Strongback had no disease incidence across both years of the study and yielded the highest amount of large and extra large fruit as well as total marketable weight. Fascination, Powerhouse, and Embasy which have resistance genes for *Fusarium* race 1 did not perform better than any of the susceptible cultivars in terms of yield and only performed better than Shoreline in disease incidence. Shoreline had significantly more disease incidence than all other cultivars with the exception of Tri-X-313, and yielded lower than Fascination (grafted and not grafted), Powerhouse, and 7197HQ. Based on these results it appears that Shoreline is the most susceptible to disease and subsequent yield loss and grafted Fascination provides the most resistance and highest yields.

This two-year study illustrates the importance of considering host plant resistance as part of a disease management program, particularly with diseases that are difficult to manage with fungicides and persist for many years. The cultivars with *Fusarium* race 1 wilt resistance (i.e. Fascination, Powerhouse, and Embasy) showed decreased effectiveness in this study, while Fascination grafted onto Carolina Strongback rootstock demonstrated complete resistance, and produced quality fruit. While the grafted cultivar had the best resistance for fusarium wilt, grafted transplants are significantly more expensive for the grower. The cost may be offset by the increase in yield, however, particularly in fields with a history of heavy disease pressure or for organic growers with very few if any fungicide options.

Host plant resistance is just one tool that can potentially be used in an integrated pest management plan for Fusarium wilt in watermelon. For more information on all available strategies that can be used for management of fusarium wilt, watch this [video featuring Dr. Keinath] on Clemson's PSA YouTube page or this [Land-Grant Press article].

Robotic Weed control Field Day Demonstrates Future Potential for Automated Management

Contributing Author: **Dr. Matt Cutulle**

Automateed weeding tehcnology demonstration at the robotics field day in Salinas, CA.

Effective weed control is critical for sustained success in commercial vegetable growing operations. Typically large vegetable operations rely heavily on labor to hand-weed the area between rows, particularly in crops that are tightly planted such as spinach, lettuce, or carrots. Increased regulations on the use of herbicides, in addition to labor shortages has pushed the vegetable industry to explore new options for weed management. One promising new technology is robotic weed control systems. Robotic weed control presents the opportunity for vegetable growers to reduce chemical and labor inputs while still maintaining a low level of weeds in the field.

Automated weeding machines use cameras to detect weeds and the crop, computer systems to identify the difference between the two in real time, and a mechanism to kill or remove the weeds. Currently there are several robotic weeders available for use including the Robovator, Steketee IC, and Garford. Several of these systems have been found to remove up to 70% of the weed material in the field, but there is still a great deal of innovation to be had to improve the cost effectiveness and efficiency of these products for growers.

Clemson recently helped to fund a robotics field day hosted by UC Davis in Salinas, California. Thirteen companies were attendance to showcase their robotic weed control platforms. Dr. Matt Cutulle, a weed specialist at the Coastal Research and Education Center, and Dr. Joe Maja, a research sensor engineer on Clemson's main campus, also attended the field day to learn about the newest technologies.

"Ultimately, we want to figure out what barriers that need to be overcome to increase the adoption of robotic weed control platforms [in South Carolina]" Dr. Cutulle said. Some of the potential challenges include the cost of equipment, farm size, diversity of crop types and row spacing, and rainfall levels. Drs. Cutulle and Maja are working to organize a similar field day in the southeast to showcase the latest technology to vegetable growers here.

One new technology showcased by Carbon Robotics utilized precision lasers to kill weeds. Weeds that grow right up against the crop are often missed by robotic weeders as the kill mechanism can damage the crop if it gets too close. Crops that are planted on tight row spacings are even more challenging in this respect. Laser removal systems can eliminate the weeds directly next to crop plants and on tight row spacings with little to no collateral damage. Hot oil is another kill mechanism being explored. Oil could be applied directly weeds right up to the crop rows without impacting the crop like targeted herbicide applications would.

While the initial cost of robotic weed control platforms is high, it can potentially offset a great deal of growers other expenses in chemical herbicides and labor. The opportunity cost of insufficient labor could also be reduced yields and vegetable quality due to insufficient weed control. Ultimately, automated management technology will be an important part of the IPM toolbox.

Fairy Ring Management in Turf Using Cultural Control

Contributing Author: **Dr. Joe Roberts**

From left to right: type one fairy ring symptoms, type two fairy ring symptoms, and type three combined with type one fairy ring symptoms.

Fairy rings are circular crops of many different species of fungi growing in turf. There are over 60 species that have been isolated and identified producing fairy ring symptoms. In highly managed turf grass stands, fairy ring symptoms can be a major issue and integrated management strategies are needed.

Many people think of fairy rings as a ring of mushrooms growing through the turf. Mushrooms are in fact just the fruiting structure produced by fungi under the right conditions. Fairy rings can occur just as readily without producing any mushrooms and just exist as a network of mycelium just above or below the soil surface. In fact, continuous mycelium of fairy ring fungi can exist for miles. This mycelium can cause several different types of fairy rings, and each symptom should be managed differently.

There are three main types of fairy rings. Type 1 fairy rings are complete or partial rings of declining or dead turf as a result of inability for water to penetrate the area affected with fungi (i.e. hydrophobicity). Type 2 fairy rings are complete or partial rings of greener turf than the surrounding area as a result of organic matter broken down by the fungi. Type 3 fairy rings are the easiest to identify, and are complete or partial rings of mushrooms growing on affected turf. Often two or even all three types of rings can be present in the same location. Each type requires a different type of management to address it.

There are cultural control strategies available for all three types of fairy rings. For type 1 fairy rings, which result from water being unable to penetrate the soil, aerification cultivation practices can help improve the situation. Using small hand tools to aerate the affected area and irrigating can help the water to penetrate the soil and improve the symptoms of a type 1 fairy ring. Type 2 fairy rings are often more visible in turf stands that are under fertilized, as the fairy ring will be more green than the surrounding area. One way to address this is to that managed sites receive sufficient fertilization. Over-applying fertilizer can also lead to a host of additional issues, but type 2 fairy rings are often most apparent in under fertilized turf. Type 3 fairy rings can be addressed simply by mowing to remove mushrooms. If they continue to persist, an increase in mowing frequency may be needed.

In some cases the cultural control strategies discussed above may need to be supplemented with an application of fungicide, particularly when dealing with type 1 fairy rings. Fungicides in the quinone outside inhibitor (FRAC code 11), succinate dehydrogenase (FRAC code 7), or demethylation inhibitors (FRAC code 3) classes generally are the most effective for fairy rings. Be sure to only apply fungicides that are labeled for use in turf, and pay special attention to products labeled for specific types of turf, such as golf courses. Not all products labeled for turf can be used for landscapes or homeowners.

Fungal mycelium on a turf sample.